

RADIOLOGICAL CONTROL MANUAL

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CHAPTER 2, RADIOLOGICAL STANDARDS

Part 1, Administrative Control Levels and Dose Limits

To accomplish the DOE objective of maintaining individual doses well below regulatory limits and to administratively control and help reduce individual and collective radiation doses, rigorous numerical administrative control levels will be established at the Site that are below the regulatory limits. These control levels will be multitiered with increasing levels of authority required to approve higher administrative control levels. Unless otherwise indicated, administrative, lifetime, and special control levels and dose limits are stated in terms of the total effective dose equivalent (TEDE), which is the sum of the doses received from internal and external sources.

Article 211, Administrative Control Level

1. The occupational dose received by the employee shall not exceed a TEDE of 5 rem in ~~1~~a year [see 10 CFR 835.202(a)(1)].
2. Site contractor management will establish an annual administrative control level based on an evaluation of historical and projected radiation exposures, workload, and mission. The administrative control level will be evaluated annually by the Radiological Control director and any changes will be approved by the Site contractor senior executive.
3. No individual will be allowed to exceed the administrative control level without the prior written approval of the Radiological Control organization, cognizant facility management, and the Radiological Control director.

Article 212, Lifetime Control Level

1. Each individual's lifetime occupational dose will be controlled below a lifetime control level of N rem where N is the age of the individual in years. Article 216 will be used to specify special control levels for radiological workers who have doses exceeding N rem based on the dosimetry information available.
2. To ensure compliance with the lifetime control level, an effort will be made to determine the lifetime occupational dose of individuals expected to receive more than 1 rem in 1 year. The lifetime occupational dose is determined by summing all occupational internal and external doses received during the individual's lifetime.
3. The internal contribution to a lifetime occupational dose from intakes prior to January 1, 1989, may be calculated in terms of either cumulative annual effective dose equivalent or committed effective dose equivalent (CEDE). The CEDE should be used to the extent that adequate data are available to calculate doses in these terms.

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Article 213, Occupational Dose Limits

- Occupational dose limits for general employees provided in Table 2-1 shall not be exceeded [see 10 CFR 835.202(a)(1)-(4)]. All occupational doses received during the current year, except the doses resulting from planned special exposures and emergency exposures, shall be included when demonstrating compliance with Table 2-1 limits [see 10 CFR 835.202(b) and 702(d)]. If formal records of an individual's prior occupational dose during the year cannot be obtained, a written estimate signed by the individual may be accepted [see 10 CFR 835.702(d)]. Written estimates will not be used as a basis for authorizing planned special exposures or emergency exposures.

Table 2-1 Summary of occupational dose limits.

Type of Exposure	Limit
General employee: whole body (internal + external) TEDE [see 10 CFR 835.202(a)(1)]	5 rem/year
General employee: lens of the eye (external) [see 10 CFR 835.202(a)(3)]	15 rem/year
General employee: skin and extremities (external shallow dose) [see 10 CFR 835.202(a)(4)]	50 rem/year
General employee: any organ or tissue (other than lens of eye) (internal + external) [see 10 CFR 835.202(a)(2)]	50 rem/year
Declared pregnant worker: embryo/fetus (internal + external) [see 10 CFR 835.206(a)]	0.5 rem/ gestation period
Minors: whole body (internal + external) TEDE [see 10 CFR 835.207]	0.1 rem/year
Minors: lens of the eye, skin, and extremities [see 10 CFR 835.207]	10% of general employee limits
CFR = Code of Federal Regulations TEDE = total effective dose equivalent Notes: <ul style="list-style-type: none"> The weighting factors in 10 CFR 835 shall be used in converting organ dose equivalent to TEDE for the whole body dose [see 10 CFR 835.203(b)]. The annual limit of dose to "any organ or tissue" is based on the committed dose equivalent to that organ or tissue resulting from internally deposited radionuclides over a 50-year period after intake plus any deep dose equivalent to that organ from external exposures during the year [see 10 CFR 835.202(a)(2)]. Exposures caused by (1) background radiation, (2) as a patient undergoing therapeutic and diagnostic medical procedures, or (3) participation as a subject in medical research programs shall not be included in either personnel radiation dose records or assessment of dose against the limits in the table [see 10 CFR 835.202(c)]. See Appendix 2A for guidance on nonuniform exposure of the skin. Whole body dose TEDE is the effective dose equivalent from external exposures plus committed effective dose equivalent from internal exposures [see 10 CFR 835.203(a)]. Lens of the eye dose equivalent is the dose equivalent from external exposure determined at a tissue depth of 0.3 cm [see 10 CFR 835.2(a)]. Shallow dose equivalent is the dose equivalent from external exposure determined at a tissue depth of 0.007 cm [see 10 CFR 835.2(a)]. 	

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2. In an exceptional situation, a radiological worker may be authorized to receive a dose that exceeds the limits specified in Table 2-1.
 - a. Planned special exposures may be authorized for an individual to receive doses in addition to and accounted for separately from doses received under the Table 2-1 limits [see 10 CFR 835.204].
 - b. Under emergency conditions, individuals may be authorized to receive doses that exceed the limits established in Table 2-1. The provisions of ~~the RCM~~[this manual](#) are not intended to limit actions necessary to protect health and safety under these conditions [see 10 CFR 835.3(d)].

A planned special exposure or emergency exposure will constitute a best management practice in few, if any, situations. Proper implementation of the provisions of ~~the RCM~~[this manual](#) will obviate the need for conducting either of the operations described under Items a or b. Therefore, specific guidance for conduct of these operations is not provided in ~~the RCM~~[this manual](#). Requirements for conducting, recording, and reporting these operations are provided in 10 CFR 835 and, for authorizing emergency exposures, in DOE emergency management orders.

3. The occupational dose limits provided in Table 2-1 apply to all general employees. However, general employees who have not completed appropriate training and examinations are not permitted unescorted access to any radiological area [see 10 CFR 835.901(b)].

Article 214, Member of the Public Dose Limit

Members of the public permitted access to a controlled area at a facility/project shall be limited to an annual radiation dose of 100 mrem from the sum of doses received from internal and external radiation sources [see 10 CFR 835.208].

Article 215, Embryo/Fetus Dose Controls

After a female worker at a facility/project voluntarily notifies her supervisor in writing that she is pregnant, for the purposes of embryo/fetal protection, she is considered a declared pregnant worker. The declared pregnant worker may revoke the declaration in writing at any time [see 10 CFR 835.2(a), declared pregnant worker].

1. The option of a mutually agreeable assignment of work tasks, without loss of pay or promotional opportunity, so that further occupational radiation exposure during the remainder of the gestational period is unlikely.
2. For a declared pregnant worker who chooses to continue work involving occupational exposure:
 - a. The dose limit for the embryo/fetus from conception to birth (entire gestational period) as a result of the occupational exposure of the declared pregnant worker is 500 mrem [see 10 CFR 835.206(a)]. The dose to the embryo/fetus is equal to the sum of doses received from external doses, sources inside the mother, and sources inside the embryo/fetus.

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- b. Measures shall be taken to avoid substantial variation above the uniform exposure rate necessary to meet the 500-mrem limit for the gestational period [see 10 CFR 835.206(b)]. Efforts will be made to avoid exceeding 50 mrem per month to the declared pregnant worker.
3. If the dose to the embryo/fetus is determined to have already exceeded 500 mrem when a worker notifies her employer of her pregnancy, the worker shall not be assigned to tasks where additional occupational radiation exposure is likely during the remainder of the gestational period [see 10 CFR 835.206(c)].

Article 216, Special Control Levels

Certain situations may require lower individual exposure control levels. In addition to considering recommendations from senior Radiological Control and medical officials, the Radiological Control director will obtain advice from professionals in other disciplines, such as Human Resources and Legal, in establishing special control levels. The Radiological Control director may wish to establish these special control levels using a radiological health advisory group.

1. A special control level for annual occupational exposure should be established for each radiological worker with a lifetime occupational dose exceeding N rem, where N is the age of the individual in years. The special control level should allow the individual's lifetime occupational dose to approach and, if practicable, fall below N rem during ensuing years as additional occupational dose is received.
2. Personnel undergoing radiation therapy or treatment involving internal intakes of medical isotopes are encouraged to inform their supervisor or the Radiological Control organization in advance of the treatment, or upon return to work. The Radiological Control organization will determine which special controls may be appropriate. Consideration will be made in the selection of special controls for internal intakes of medical isotopes that include ensuring (a) thermoluminescent dosimeters (TLDs) are not exposed to medical sources of radiation and (b) monitoring for personnel contamination is also not affected by the medical isotope.
3. Special controls on an individual dose will not be implemented in a manner that interferes with an individual's right to work. If reasonable efforts to implement a special control level below the annual administrative control level threaten to restrict the individual's right to work or are otherwise unsuccessful, the Site contractor senior executive will evaluate and consider, when appropriate, any doses in excess of the applied special control level, but not to exceed the regulatory dose limits.

Part 2, Contamination Control and Control Levels

Control of radioactive contamination at the facility/project will be, where practicable, achieved by using engineering controls and worker performance to contain contamination at the source, reducing existing areas of contamination, and promptly decontaminating areas that become contaminated.

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Article 221, Personnel Contamination Control

1. See Article 338 for personnel contamination monitoring requirements and guidance. This guidance is not relevant to individuals exiting areas containing only radionuclides such as tritium that cannot be detected using hand-held or automatic frisking equipment.
2. Monitoring for contamination will be performed using frisking equipment, or other applicable monitoring equipment, that can detect total contamination at or below the values specified in Table 2-2. The facility/project will use automatic monitoring units that meet the above requirements, if practicable.
3. Individuals found with detectable contamination on their skin or personal clothing, other than noble gases or natural background radioactivity, will be decontaminated promptly as described in Article 541.

Article 222, Contamination Control Levels

1. A surface is considered contaminated if either the removable or the total surface contamination exceeds the values listed in Table 2-2. Controls shall be implemented for these surfaces commensurate with the nature of the contaminant and level of contamination [see 10 CFR 835.1102(b)]. Appropriate postings and controls are established in Part 3 of this chapter and Chapters 3 and 4.
2. Surfaces exceeding the values of Table 2-2 for total contamination may be covered with a fixative coating to prevent the spread of contamination. However, reasonable efforts will be made to decontaminate an area before a coating is applied. A fixative coating should not be applied without the approval of the Radiological Control director or designee.
3. Appropriate controls for areas of fixed contamination are provided in Article 224.
4. For areas with contaminated soil that is not releasable in accordance with DOE environmental protection standards, a soil contamination area should be established that:
 - a. Is posted as specified in Article 238.
 - b. Meets the requirements of Article 231.1 through 231.8.
5. Soil contamination areas may be located outside a radiological buffer area.

Article 223, Airborne Radioactivity Control Levels

1. Use of engineering and administrative controls to reduce the potential for internal exposure will be evaluated before allowing individuals, with or without respiratory protection, to enter areas with airborne radioactivity.
2. Posting requirements for areas with airborne radioactivity are specified in Article 235. The values of derived air concentrations (DACs) that are provided in 10 CFR 835 Appendixes A and C shall be used in the control of occupational exposures to airborne radioactive material [see 10 CFR 835.209(a)].

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Table 2-2. Summary of surface contamination values.^a

Radionuclide	Removable (dpm/100 cm ²) ^{b,e,d}	Total (Fixed + Removable) (dpm/100 cm ²) ^{b,c}
U-natural, U-235, U-238, and associated decay products	1,000 alpha	5,000 alpha
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, and I-129	0 ^e	0 ^e
Th-natural, Th-232, Sr-90, ^f Ra-223, Ra-224, U-232, I-126, I-131, and I-133	200	1,000
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above; and mixed fission products containing Sr-90 ^f	1,000 beta-gamma	5,000 beta-gamma
Tritium and tritiated compounds ^g	10,000	NA

CFR = Code of Federal Regulations

NA = not applicable

a. Except as indicated in footnote ~~f~~^g below, the values in this table apply to radioactive contamination deposited on, but not incorporated into the interior of, the contaminated item. Where contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for the alpha- and beta-gamma-emitting nuclides apply independently [see 10 CFR 835, Appendix D].

b. As used in this table, dpm means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

c. The levels may be averaged over 1 m² provided the maximum activity in any area of 100 cm² is less than three times the values in Table 2-2. For the purposes of averaging, any square meter of surface shall be considered to be above the surface contamination value if (1) from measurements of a representative number of sections, the average contamination level is determined to exceed the applicable value or (2) the sum of the activity of all isolated spots or particles in any 100-cm² area is determined to exceed three times the applicable value in Table 2-2 [see 10 CFR 835, Appendix D].

d. The amount of removable radioactive material per 100 cm² of surface area will be determined by swiping the area with dry filter or soft absorbent paper while applying moderate pressure and then assessing the amount of radioactive material on the swipe with an appropriate instrument of known efficiency. (However, the use of dry material may not be appropriate for tritium.) For objects with a surface area less than 100 cm², the entire surface will be swiped, and the activity per unit area will be based on the actual surface area. The use of swiping techniques is not necessary to measure removable contamination levels if direct scan surveys indicate that the total residual contamination levels are below the values for removable contamination [see 10 CFR 835, Appendix D].

e. Items to be released exceeding the values specified require an evaluation to be performed and documented:

- If the removable contamination is less than 20 dpm/100 cm², the item may be released.
- If the total beta-gamma contamination is less than 100 dpm/100 cm², the item may be released.
- Any items with total TRU alpha contamination will not be released.

f. These values will be applied to total Sr-90/Y-90 activity resulting from processes involving the separation or purification of Sr-90. For mixed fission products containing Sr-90:

- If the Sr-90 fraction is 50% or less of the total activity, the mixed fission product surface activity values apply.
- If the Sr-90 fraction is between 50% and 90% of the total activity, the surface radioactivity values should be 3000 dpm/100 cm² total and 600 dpm/100 cm² removable.
- If the Sr-90 fraction exceeds 90% of the total activity, the Sr-90 surface activity values apply (RCTP 96-02).

g. Tritium contamination may diffuse into the volume or matrix of materials. Evaluation of surface contamination shall consider the extent to which such contamination may migrate to the surface to ensure that the surface radioactivity value provided in this table is not exceeded. Once this contamination migrates to the surface, it may be removable, not fixed; therefore, a "Total" value does not apply [see 10 CFR 835, Appendix D].

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Article 224, Areas of Fixed Contamination

Areas having only fixed contamination usually do not warrant the full range of entry controls established for areas having removable contamination levels exceeding the Table 2-2 values. Areas located outside of radiological areas having measured total contamination exceeding the total surface contamination values specified in Table 2-2 (with removable contamination levels below Table 2-2 values) are subject to the following controls:

1. Periodic surveys shall be conducted to ensure that the surface contamination remains fixed to the surface and removable surface contamination levels remain below Table 2-2 values [see 10 CFR 835.1102(c)(1)].
2. Markings indicating the status of the area shall be applied [see 10 CFR 835.1102(c)(2)]. These markings will be applied directly to the surface or at the access points to provide appropriate warning. Unidentified areas of fixed contamination at facilities or projects will be controlled as they are identified by radiological surveys. This level of control is consistent with the intent of the requirement and is not considered to be an off-normal event. Locations of areas with multiple fixed contamination may be posted at access points. These markings also may provide appropriate instructions to individuals entering the area or coming in contact with the surface (e.g., “fixed contamination” or “fixed contamination, notify radiological control personnel prior to removing paint”). Signs, stencils, or other appropriate markings may be used. See Table 2-5 for posting requirements of fixed contamination areas.
3. Records of areas with fixed contamination will be maintained.
4. Markings and postings will be maintained in a legible condition.
5. Appropriate written procedures will be implemented to prevent unplanned or uncontrolled removal of the contamination. These procedures will address issues such as access controls and fixative coatings, if needed, survey techniques and frequency, area tracking and maintenance, and required markings.
6. If surveys indicate that contamination is likely to be transferred from the area, fixative coatings should be applied. When paint is used as a fixative coating, it should consist of two layers having contrasting colors, to provide indication of erosion of the top layer. The bottom layer should be magenta and the top layer contrasting such as white. Other fixative coatings, such as strippable coatings and applied plastics and foams, will be periodically evaluated for evidence of degradation. Removable contamination will be reduced to the minimum practicable level before application of fixative coatings using an approved work document.
7. Areas meeting these requirements are exempt from the posting requirements of Articles 232 through 238 and the entry and exit requirements of Chapter 3.

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Part 3, Posting**Article 231, General Posting Provisions**

1. Radiological postings are intended to alert individuals to the presence of radiation and radioactive materials and to aid them in controlling exposures and preventing the spread of contamination. The types of boundaries used for radiological control purposes are depicted in Figure 2-1.
2. Signs shall contain the standard radiation symbol (radiation warning trefoil) colored black or magenta on a yellow background [see 10 CFR 835.601(a)]. Lettering should be black or magenta. Standardized signs, as described in DOE core training and 10 CFR 835 guides, will be used where practicable.
3. The Radiological Control director may modify posting requirements to reflect the special considerations of DOE activities conducted at private residences or businesses. Such modifications shall provide the same level of protection to individuals as the existing provisions in 10 CFR 835 [see 10 CFR 835.601(c)].
4. Signs shall be clearly and conspicuously posted at each access point, clearly worded, and, where appropriate, may include radiological control instructions [see 10 CFR 835.601(b)]. Radiological postings will be displayed only to signify actual or potential radiological conditions. Signs used for training will be clearly marked such as "For Training Purposes Only."
5. Areas that are not normal access points to high radiation areas, and require earth-moving or rigging gear (e.g., large deck plugs or roof hatches) to access, require no posting or weekly checks. Such access points should be controlled by a work document that directs installation of postings when opened. An evaluation of each such area will be performed and documented using an engineering design file (or other listing method such as incorporating the evaluation in the appropriate facility high radiation area control notebook) to determine whether it is a normal access point.
6. Posted areas will be as small as practicable for efficiency.
7. Postings will be maintained in a legible condition and updated based on the results of the most recent surveys.
8. If more than one radiological condition (such as contamination and high radiation) exists in the same area, each condition should be identified.
9. In areas of ongoing work activities, the dose rate and contamination level or range of each will be included on or in conjunction with each posting, as applicable.
10. Postings at entrance points to areas of ongoing work activities controlled for radiological purposes will state basic entry requirements such as dosimetry, radiological work permits (RWPs), or other written authorization, and respiratory protection requirements.

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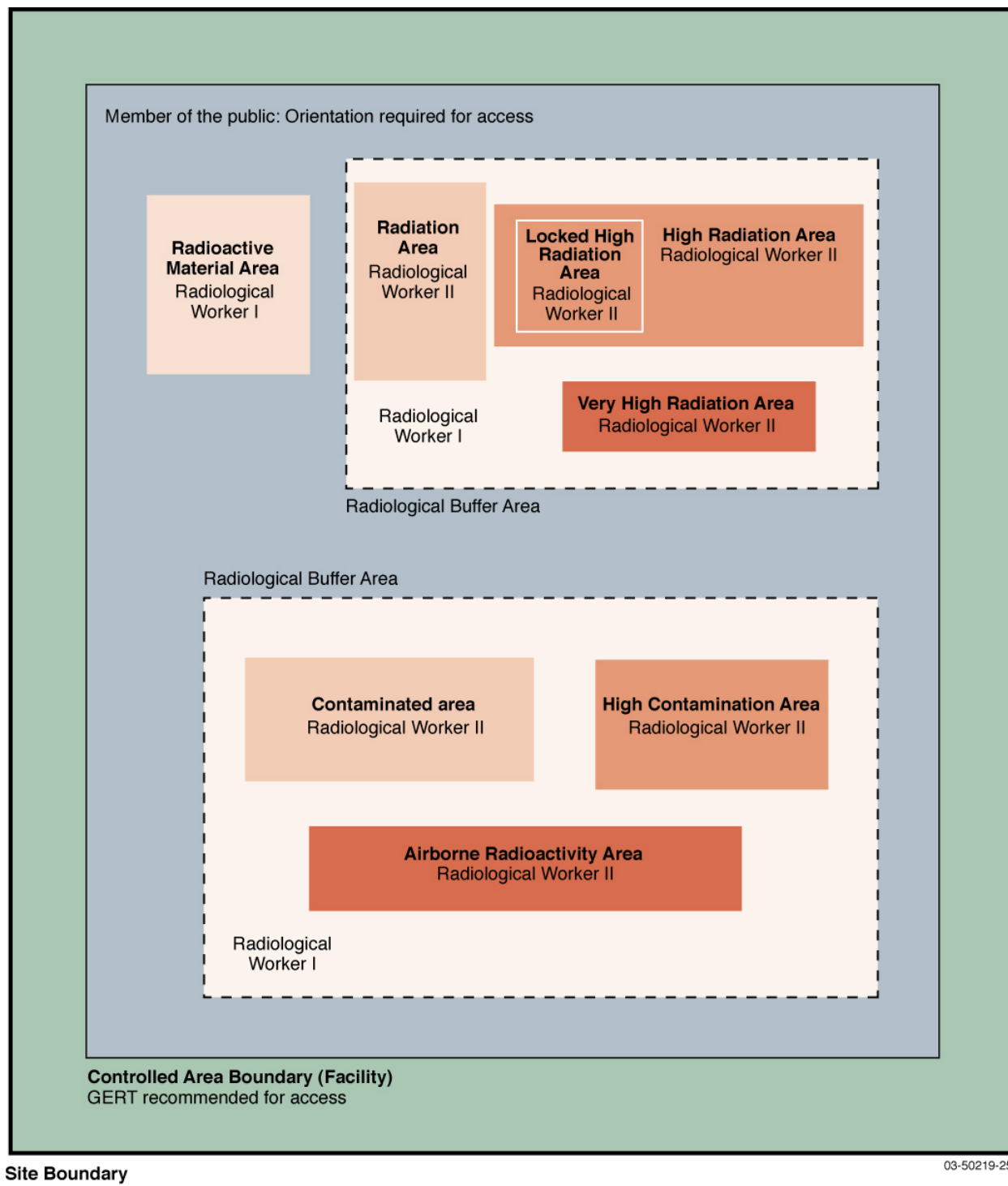


Figure 2-1. Types of posting for and training to access radiologically controlled areas.

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11. Rope, tape, chains, and similar barriers used to designate the boundaries of posted areas should be yellow and magenta in color.
12. Physical barriers will be placed so that they are clearly visible from all directions and at various elevations. They are not to be easily walked over or under, except at identified access points. These barriers shall be set up so that they do not impede the intended use of emergency exits or evacuation routes [see 10 CFR 835.501(e), 502(d)].
13. Areas shall be clearly and conspicuously posted [see 10 CFR 835.601(b)]. Doors will be posted so that the posting remains visible when doors are open or closed.
14. A radiological posting that signifies the presence of an intermittent radiological condition should include a statement specifying when the radiation is present, such as "CAUTION: RADIATION AREA WHEN RED LIGHT IS ON."
15. Accessible areas may be ~~excepted~~exempted from radiological area posting requirements:
 - a. During transient radiological conditions less than 8 continuous hours in duration when posting is not practical, such as during radioactive material transfers. Under these conditions, the area shall be placed under the continuous observation and control of individuals who are knowledgeable of and empowered to implement required access and exposure control measures [see 10 CFR 835.604(a)]. These individuals will be stationed to provide line of sight surveillance and verbal warnings.
 - b. When an area contains only packages received from radioactive material ~~transportation shipments that are~~ labeled and in nondegraded condition while awaiting survey in accordance with Articles ~~552 and 554~~ 423 [see 10 CFR 835.604(c)].

The exceptions discussed above apply only to posting requirements for radiological areas and radioactive material areas and do not apply to the entry control requirements established in 10 CFR 835.501 and 10 CFR 835.502.

Article 232, Posting Controlled Areas

Controlled areas are established and posted to warn individuals when they are entering areas controlled for radiation protection purposes. All radiological areas and radioactive material areas lie within the boundaries of controlled areas. Individuals who enter only the controlled area without entering radiological areas or radioactive material areas are not expected to receive a TEDE exceeding 100 mrem in a year.

1. Each access point to a controlled area shall be posted whenever radiological areas or radioactive material areas may be present in the area [see 10 CFR 835.602(a)].
2. A sign will be used to avoid conflict with the Site security requirements [see 10 CFR 835.602(b)]. The Radiological Control director will approve any sign change.

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Article 233, Posting Radiological Buffer Areas

Radiological buffer areas are intended to provide secondary boundaries within a controlled area to minimize the spread of contamination and to limit doses to general employees who have not been trained as radiological workers.

1. A radiological buffer area should be established for contamination control adjacent to any entrance to or exit from a contamination, high contamination, or airborne radioactivity area. The size of the radiological buffer area will be commensurate with the potential for the spread of contamination.
2. Radiological buffer areas ~~will~~should be established for exposure control adjacent to radiation, high radiation, and very high radiation areas. The boundary for the radiological buffer area will be established to limit radiation doses to general employees to less than 100 mrem per year.
3. A radiological buffer area is not required for:
 - a. High contamination or airborne radioactivity areas that are completely within contamination areas.
 - b. Inactive contamination, high contamination, or airborne radioactivity areas (i.e., areas to which entry has been prohibited by posting or barricades).
 - c. Exposure control if other posted boundaries or controls provide equivalent employee protection.
 - d. Exposure control if general employees who are not trained as radiological workers are restricted from unescorted entry to controlled areas.
4. The need for radiological buffer areas around radioactive material areas, soil contamination areas, and underground radioactive material areas will be evaluated based on the potential for exposure of unmonitored individuals and the spread of contamination.
5. Posting of radiological buffer areas will be in accordance with Article 231 and contain the wording "CAUTION, RADIOLOGICAL BUFFER AREA." See Table 2-5 for posting requirements for radiological buffer areas.

Article 234, Posting Radiation Areas

1. Radiation areas shall be posted to alert individuals to the presence of external radiation in accordance with Table 2-3 [see 10 CFR 835.601, 603]. In addition, hot spots will be labeled as described below to provide warning of discrete radiation sources.
2. Radiation areas and high radiation areas shall be identified based on the dose rates at a distance of 30 cm either from the source or from any surface penetrated by the radiation [see 10 CFR 835.2(a), radiation area and high radiation area]. Very high radiation areas shall be identified based on the dose rate at a distance of 100 cm either from the source or from any surface penetrated by the radiation [see 10 CFR 835.2(a), very high radiation area].

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Table 2-3. Criteria for posting radiation areas.

Area	Criteria Required	Posting	Supplemental Posting
Radiation area	Radiation levels could result in an individual receiving > 0.005 rem in 1 hour at 30 cm	“CAUTION, RADIATION AREA” [see 10 CFR 835.603(a)]	“RWP AND PERSONNEL DOSIMETER REQUIRED FOR ENTRY”
High radiation area	Radiation levels could result in an individual receiving > 0.1 rem in 1 hour at 30 cm	“CAUTION,” or “DANGER,” “HIGH RADIATION AREA” [see 10 CFR 835.603(b)]	“PERSONNEL DOSIMETER, SUPPLEMENTAL DOSIMETER, AND RWP REQUIRED FOR ENTRY”
Very high radiation area	Radiation levels could result in an individual receiving > 500 rad in 1 hour at 100 cm	“GRAVE DANGER, VERY HIGH RADIATION AREA” [see 10 CFR 835.603(c)]	“SPECIAL CONTROLS REQUIRED FOR ENTRY” ^a
RWP = radiological work permit a. Access requirements may be deleted or modified if personnel access is specifically prohibited.			

3. Contact readings will be used to determine the need for labeling hot spots. Measures taken to identify sources of elevated general area radiation levels while conducting routine radiation surveys are sufficient to identify hot spot locations. Special surveys for the sole purpose of identifying hot spots are not required.
4. A label reading “Caution, Hot Spot” and marking the location of the hot spot will be placed on or as near the spot as practicable. The provisions of Articles 231.7 through 231.11 do not apply to the hot spot labeling. Labeling of hot spots is not required in areas with general area dose rates greater than 1 rem/hour. However, the locations of such hot spots will be noted on area surveys and discussed in pre-job briefings.
5. Dose received in an hour may be used as the criterion for posting (see the Criteria Required column of Table 2-3). For very high doses received at high dose rates (such as doses received in a very high radiation area), dose rates will be measured and recorded in units of ~~radiation absorbed dose (rad)~~ rather than ~~roentgen equivalent man (rem)~~ in 1 hour.

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Article 235, Posting Contamination, High Contamination, and Airborne Radioactivity Areas

1. Areas shall be posted to alert individuals to the presence (or likely presence) of surface contamination and airborne radioactivity in accordance with Table 2-4 [see 10 CFR 835.603].
2. Derived air concentration values found in 10 CFR 835, Appendixes A and C, shall be used in posting airborne radioactivity areas in accordance with Table 2-4 [see 10 CFR 835.209(a)].

Table 2-4. Criteria for posting contamination, high contamination, and airborne radioactivity areas.

Area	Criteria	Required Posting	Supplemental Posting
Contamination area	Removable contamination levels (dpm/100 cm ²) > Table 2-2 values ^a but ≤ 100 × Table 2-2 values	“CAUTION, CONTAMINATION AREA” [see 10 CFR 835.603(e)]	“RWP AND PROTECTIVE CLOTHING REQUIRED FOR ENTRY”
High contamination area	Removable contamination levels (dpm/100 cm ²) > 100 × Table 2-2 values ^a	“CAUTION,” or “DANGER,” “HIGH CONTAMINATION AREA” [see 10 CFR 835.603(f)]	“RWP AND PROTECTIVE CLOTHING REQUIRED FOR ENTRY”
Airborne radioactivity area	Airborne concentrations (μCi/mL) above background: (1) are > the applicable DAC values ^a ; or (2) could result in an individual (without respirator) receiving an intake > 12 derived air concentration -hours in a week	“CAUTION,” or “DANGER, AIRBORNE RADIOACTIVITY AREA” [see 10 CFR 835.603(d)]	“RWP AND PROTECTIVE CLOTHING REQUIRED FOR ENTRY”
DAC = derived air concentration value RWP = radiological work permit a. Levels exceed or are likely to exceed the listed values.			

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Table 2-5. Criteria for posting fixed, soil contamination, and radiological buffer areas.

Area	Criteria	Required Posting
Fixed contamination	Removable contamination levels < Table 2-2 removable values and total contamination levels > Table 2-2 total values	“CAUTION, FIXED CONTAMINATION”
Soil contamination	Contaminated soil not releasable in accordance with DOE O 5400.5, “Radiation Protection of the Public and the Environment”	“CAUTION, SOIL CONTAMINATION AREA”
Radiological buffer area	See Article 233 for criteria	“CAUTION, RADIOLOGICAL BUFFER AREA”

Article 236, Posting Radioactive Material Areas

1. Accessible areas where items or containers of radioactive material in quantities exceeding the values provided in 10 CFR 835, Appendix E, are used, handled, or stored shall be posted “CAUTION, RADIOACTIVE MATERIAL” [see 10 CFR 835.603(g)].
2. Radioactive material areas shall be located within controlled areas [see 10 CFR 835.2(a)].
3. Radioactive material areas may be ~~exempted~~~~excepted~~ from the posting requirements when:
 - a. The area is posted as a radiological area in accordance with Articles 234 or 235 [see 10 CFR 835.604(b)(1)].
 - b. Each item or container of radioactive material in the area is clearly labeled to warn individuals of the hazards [see 10 CFR 835.604(b)(2)].
 - c. The radioactive material of concern consists solely of structures or installed components that have been activated (such as by exposure to neutron radiation or particles produced in an accelerator) [see 10 CFR 835.604(b)(3)].
 - d. The area contains only packages received from radioactive material ~~transportation shipments~~ that are labeled, in nondegraded condition, and awaiting monitoring in accordance with Articles ~~552 and 554~~ 423.2 [see 10 CFR 835.604(c)].
 - e. For periods of 8 continuous hours or less, the area is under the continuous observation and control of an individual knowledgeable of, and empowered to implement, required access and exposure control measures [see 10 CFR 835.604(a)].
4. Provisions for labeling radioactive material are specified in Chapter 4.

Article 237, Posting Underground Radioactive Material Areas

1. Underground radioactive material areas should be established to indicate the presence of underground items that contain radioactive materials such as pipelines, radioactive cribs,

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- covered ponds, covered ditches, catch tanks, inactive burial grounds, and sites of known, covered, and unplanned releases (spills). Underground radioactive material areas need not be posted if physical or administrative controls are implemented to ensure appropriate radiological controls are established prior to excavating, penetrating, or otherwise disturbing underground radioactive materials.
2. Underground radioactive material areas should be posted “UNDERGROUND RADIOACTIVE MATERIAL.” Posting will include instructions or special warnings to workers such as “Consult With Radiological Control Organization Before Digging” or “Subsurface Contamination Exists.” The posting should meet the applicable requirements of Article 231.
 3. Two methods will be used at the facility/project to post underground radioactive material areas. Gated facilities will have postings meeting the requirements listed in Items 1 and 2 above at the entrance gates to these facilities. All other facilities will have postings to identify the underground radioactive material area. For items such as contaminated sewer pipes, signs will be posted at the openings, or as close as practicable. If the opening is in a roadway or high traffic area, then the posting may be stenciled on or near the opening or on a sign placed as close as practicable.
 4. Underground radioactive material areas may be located outside controlled areas unless access is likely to result in individual doses (TEDE) greater than 100 mrem in 1 year from underground radioactive material.
 5. Underground radioactive material areas are exempt from the entry and exit requirements of Chapter 3 when access is not likely to result in individual doses greater than 100 mrem in 1 year. Article 333.1 provides entry provisions for instances in which access is likely to result in an individual dose greater than 100 mrem in 1 year.

Article 238, Posting Soil Contamination Areas

1. For areas with contaminated soil that is not releasable in accordance with DOE environmental protection standards, a soil contamination area will be established that is posted in accordance with the requirements in Articles 231.1 through 231.8. Posting will include the words “Caution, Soil Contamination Area” and instructions or special warnings to workers, such as “Consult With Radiological Control Organization Before Digging” or “Subsurface Contamination Exists” (see Table 2-5).
2. Soil contamination areas may be located outside controlled areas if exposure to the material in the area is not likely to cause any individual to receive a TEDE in excess of 100 mrem in a year.
3. If the contamination levels in the area exceed the values provided in Table 2-2 (as evidenced by the likelihood of tracking contamination out of the area at levels exceeding these values), then the area is a contamination area or high contamination area and shall be posted in accordance with Article 235 [see 10 CFR 835.2(a), and 10 CFR 835.603(e) and (f)].

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Appendix 2A**Nonuniform Exposure of the Skin**

Nonuniform exposures of the skin from x-rays, beta radiation, or radioactive materials on the skin, including hot particles, shall be assessed and recorded as specified in the table below [see 10 CFR 835.205(a)].

Table 2A-1. Methods of assessing and recording nonuniform exposures of the skin.

Area of Skin Irradiated	Method of Averaging, Method of Adding to Other Doses Received, and Recording Nonuniform Skin Dose
$\geq 100 \text{ cm}^2$ [see 10 CFR 835.205(b)(1)]	<ol style="list-style-type: none"> 1. Averaged over 100 cm^2 of skin receiving the maximum dose. 2. Added to any uniform dose equivalent also received by the skin. 3. Recorded as the shallow dose equivalent to any extremity or skin for the year.^a
$\geq 10 \text{ cm}^2$ and $< 100 \text{ cm}^2$ [see 10 CFR 835.205(b)(2)]	<ol style="list-style-type: none"> 1. Averaged over 1 cm^2 of skin receiving the maximum absorbed dose (D), reduced by the fraction (f), which is the irradiated area in square centimeters divided by 100 cm^2 ($H=f \cdot D$). In no case, shall a value of < 0.1 be used for "f". 2. Added to any uniform dose equivalent also received by the skin. 3. Recorded as the shallow dose equivalent to any extremity or skin for the year.^a
$< 10 \text{ cm}^2$ [see 10 CFR 835.205(b)(3)]	<ol style="list-style-type: none"> 1. Averaged over 1 cm^2 of skin receiving the maximum dose 2. Not added to any other shallow dose equivalent to any extremity or skin recorded as the dose equivalent for the year. 3. Recorded in an individual's radiation dose record as a special entry.^a
<p>CFR = Code of Federal Regulations a. Recording of shallow dose equivalents resulting from nonuniform exposure of the skin is not required if the resulting dose is less than 1 rem [see 10 CFR 835.702(b)].</p>	